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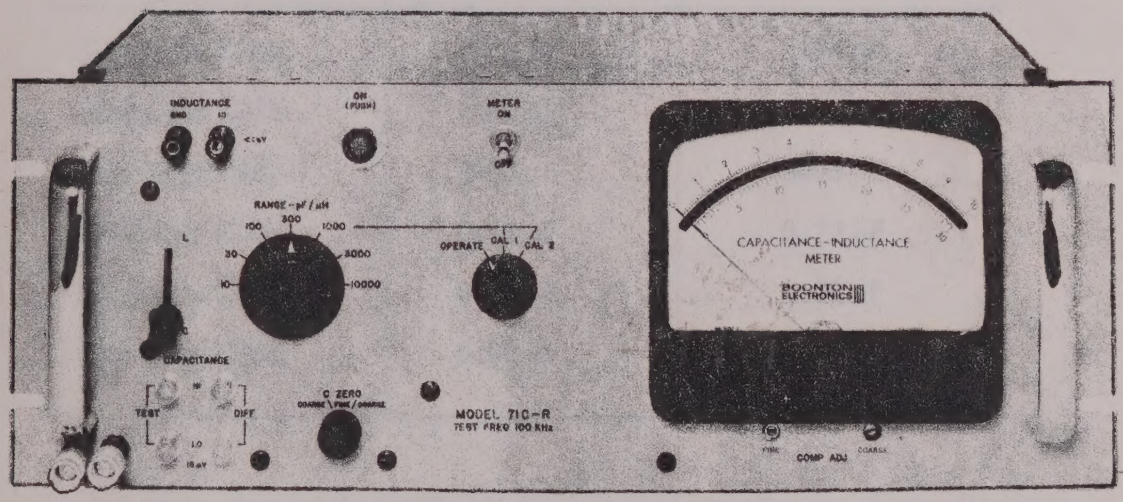
OPERATING INSTRUCTIONS

MODEL 71CR

CAPACITANCE/INDUCTANCE METER



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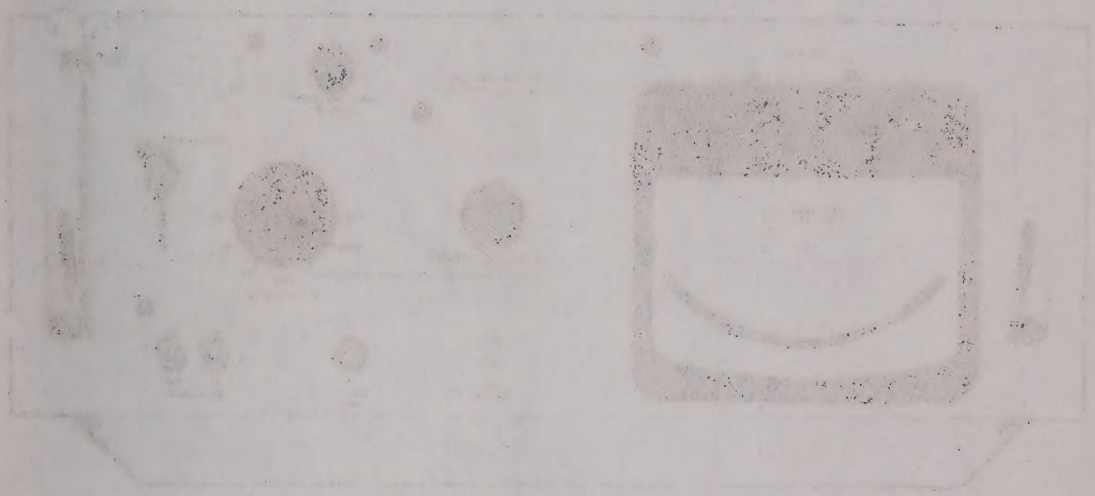

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W42

71CR ERRATA NO. 1

The value of some component parts have been changed in models having serial numbers 111 or higher. Change and amend the schematic diagram at the rear of Operating Instructions Model 71CR Capacitance/Inductance Meter as follows:

Item	Value	Change value to:
Capacitor C110,	992 pF	994 pF
Capacitor C213	1100 pF	1200 pF
Capacitor C402	2800 pF	3000 pF
Capacitor C503	0.02 μF	0.22 μF
Capacitor C504	0.02 μF	0.22 μF
Capacitor C505	0.02 μF	0.22 μF

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SECTION 1

Specifications

Capacitance Measurements (3-terminal):

Range..... 0 to 10,000 pF in 7 ranges; lowest range, 10 pF fs

Accuracy..... 0.5% of reading + $(0.5\% + \frac{3}{Q}\%)$ fs + 0.1 pF

Resolution..... 0.25%

Inductance Measurements (2-terminal):

Range ..... 0 to 10 mH in 7 ranges; lowest range, 10 μH fs

Accuracy..... 0.5% of reading + $(0.5\% + \frac{6}{Q}\% + \frac{L^*}{10}\%)$ fs + 0.1 μH

(* Where L = inductance of the test specimen in mH)

Resolution 0.25%

Test Signal:

Frequency..... 100 KHz, crystal controlled

Level ..... Capacitance measurements, 15 mV; inductance measurements, less than 1 mV.

DC Bias: (For capacitance measurements only)
External bias up to ±200 V at 250 mA may be applied at rear terminals; bias circuit protected from overload by 250 m A fuse.

DC Analog Output:

Level ..... 0 to 100 mV or 0 to 300 mV depending on full scale numerics; also > 1 V fs for loads > 10 MΩ.

Linearity ..... 0.1% of reading + 0.005% fs

Response Time ..... <20 ms

Primary Power..... 117 or 234 V (±10%), 50/60 cps: 40 watts

Dimensions ..... 7" high, 19" wide, 9" deep

Weight ..... 14 lb unpacked; 21 lb packed

SECTION II

General Description

2-1 MODEL 71CR

The Model 71CR provides instant, direct-reading, three-terminal capacitance measurements and two-terminal inductance measurements at 100 KHz. The measuring capabilities of 0 to 10,000 pF and 0 to 10 mH are each covered in 7 ranges in a 1-3-10 sequence.

The internally supplied 100 KHz test signal is crystal controlled. The instrument operates with low test levels as required for many semiconductor measurements.

Terminals at a rear panel permit application of an externally supplied dc bias up to ±200 volts to the test specimen for capacitance measurements only. Bias cannot be provided for inductance measurements.

A linear dc output is available at rear panel terminals which is proportional to the meter reading. This output extends the range of application allowing connection of such readout devices as digital voltmeters, x-y plotters or recorders.

2-2 EXPLANATION OF CONTROLS AND ADJUSTMENTS

2-2-1 Front Panel

RANGE - pF/μH: Seven-position switch selects measuring ranges having full scale values of 10, 30, 100, 300, 1000, 3000, and 10,000 with units of measurements being either picofarads or microhenries, as determined by the position of the "L/C" selector.

C ZERO: Provides means for balancing out capacitance across the "TEST" terminals (up to approximately 7 pF) contributed by exposed terminations of connecting cables, test fixtures, etc. Its range may be increased by attaching an external capacitance to the "DIFF" posts, as outlined in paragraph 3-7.

NOTE:

This is a dual ratio control which adjusts a variable air capacitor having a full 360° of rotation. It will be noted that for about 270° of rotation of the "C ZERO" control, it turns very easily. Beyond this point the torque requirement increases abruptly, indicating a shift from the 36:1 "fine" ratio to the 6:1 "coarse" ratio.

COMP ADJ: The front panel "COMP ADJ" controls adjust a variable air capacitor and switched fixed capacitors which negate stray capacitance from the high post to ground (such as those existing between the inner and outer conductors of coaxial cable) to eliminate its effects on measurements. This control will tune out approximately 550 pf. As a rule of thumb, the amount of "HI"-post-to-ground capacitance required to cause 1% of full-scale error is somewhat greater than three times the full scale value of the range for all ranges. Thus, it can be seen that the amount of "HI"-post-to-ground capacitance encountered in the great majority of cases will be of minor significance, and require balancing only on the lower ranges. However, when working on the 30 pF range or lower, the "COMP ADJ" adjustments should be checked when:

a. The instrument is initially put into service.

b. Any change is made in the connection system. (For example, going from remote measurements to local measurements or vice versa, changing connecting cables or test fixtures, etc.).

c. Measuring a standard capacitor.

d. Testing a specimen having markedly different "HI"-to-ground capacitance than those tested previously with a given connection system (as caused by considerable differences in internal construction, encasing, or terminations).

CAPACITANCE TEST: BNC connectors for the test specimen. Measurements may be made either locally or remotely by means of coaxial cables.

CAPACITANCE DIFF: A given capacitance connected to the "TEST" terminals produces an accurately calibrated up-scale reading. Attaching the same capacitance to the "DIFF" post causes a comparable down-scale reading. These connections are useful for such functions as making differential capacitance measurements, extending the measuring range upwards, or extending the range of the "C ZERO" control. There are certain limitations on the use of the "DIFF" posts which are detailed in paragraphs 3-5, 3-6, and 3-7.

L/C: This switch selects a condition for measurement of either inductance or capacitance.

INDUCTANCE: Test terminals for inductance measurements. Measurements should be made directly at the terminals.

ON (PUSH): The main power switch (push for on, pull for off); the translucent red button serves as the pilot light. This assembly also contains the primary power fuse, which may be removed by rotating the black ring counterclockwise and withdrawing the fuse holder.

MECHANICAL ZERO: This adjusts the meter pointer to a mechanical zero. It should be checked with the instrument switched off, or the meter switch off.

OPERATE/CAL 1/CAL 2: For measuring, this selector is left in the "OPERATE" position. When set to "CAL 1" or "CAL 2", it switches in the internal 1000 pF standard capacitor for high-Q or low-Q calibration checks, respectively. (See paragraph 3-10.)

METER ON/OFF: There is no interaction between the indicating meter and the DVM output except for a small counter-emf from the moving coil of the meter movement. With varying meter readings, this emf may show up as slight irregularities in the dc output; switching the meter off eliminates this. In addition, switching the meter off eliminates needless wear of the meter movement when the dc output is used.

2-2-2 Rear Panel

± BIAS: This terminal and BIAS GND provide for application of the dc bias voltage up to ±200 volts at 250 mA to the capacitance test specimen. Bias voltage appears across both "TEST" and "DIFF" terminals.

FUSE: 250 mA fuse prevents internal damage in case the bias voltage is short-circuited at the "TEST" or "DIFF" terminals either by accidental contact or by a shorted test specimen. See paragraph 3-8 for further details.

DVM+: Connection to this terminal and the "GND" terminal immediately below provides a dc analog of the measured value suitable for use with a digital voltmeter. Output for full scale is 100 mV or 300 mV depending upon numerics of the selected range, so that when ranges are switched the dvm follows automatically.

1.1 MΩ RESISTOR: For dvm's having an input resistance of 10 megohms or greater, this resistor should be left in position. For dvm's having an input resistance of 1 megohm, it should be removed. Instruments having less than 1 megohm input resistance should not be used.

GND: Ground connection for DVM or REC output.

REC: Connection to this terminal and to the "GND" terminal provides a linear analog output of the measured value, whose level varies from 0 to approximately 1.7 volts (into loads greater than 10 megohms) for full scale on all ranges.

DVM ADJ: This control adjusts the level of the dc analog output so that the dvm will be in agreement with a standard capacitor. See paragraph 3-14-4.

CAL 1: Calibration adjustment for high Q measurements. For calibration procedures, see paragraph 3-10.

CAL 2: Calibration adjustment for low Q measurements. For calibration procedure, see paragraph 3-10.

10,000 pF ZERO: Zero adjustment for 10,000 pF range. Once set on initial installation, this control will rarely need readjustment. However, since the setting of this control is vital to proper operation for either capacitance or inductance measurements, it is recommended that it be checked periodically. (See paragraph 3-1-4-2 (f) and (g) for procedure).

GND: Ground connection for dc bias input.

2-2-3 Top Cover

INTERNAL INDUCTANCE COMPENSATION: This factory adjustment compensates for inductance of internal wiring. Pre-set at the factory, this control should not require readjustment. (Third hole from left).

L ZERO: This control provides a means for zeroing the instrument on the 10 μH range in accordance with the procedure outlined in paragraph 3-13. (Second hole from left).

10 mH CALIBRATION: This control provides means for individually calibrating the 10 mH range; it is pre-set at the factory and does not require readjustment. (Left hand hole).

Adjustments for the internal 1000 pF standard capacitor. These are set at the factory and should not require readjustment. (Fourth and fifth holes from left).

SECTION III

Operating Instructions

3-1 INITIAL INSTALLATION

3-1-1 Unpacking

On unpacking, inspect the instrument for possible damage in transit. If the instrument is damaged, contact your local sales engineering representative or the Boonton Electronics Corporation (see title page for factory address) for further instructions. If no damage is found, the instrument may be put into service by the following procedure:

3-1-2 Mechanical Zero Adjustment

With the instrument unpowered and in a normal operating position, check to see that the indicator needle rests at zero. If not, set to zero by adjusting the mechanical zero control on the meter housing.

3-1-3 Turn-on Procedure and Warm-up

Plug the instrument into a source of 117 V (±10%) 50/60 Hz power and push the front panel ON button. The instrument may be operated approximately 30 seconds after turn-on. However, for maximum accuracy, a warm-up of approximately a half-hour should be allowed. The translucent red center button of the ON switch also serves as the pilot light. This switch is turned off by pulling the outer black disk outward. It should be noted that this switch also serves as the fuse holder. (To remove the fuse, turn the switch off, twist the black ring counterclockwise, and withdraw the assembly.)

3-1-4 Initial Installation Checks and Adjustments

3-1-4-1 General

Before the instrument is put into service, perform the following initial checks and adjustments:

a. Allow an initial warm-up of a half hour.

b. Set the L/C selector to C.

c. With the instrument on the 10 pF range, and no specimen connected to the "TEST" terminals, set the indicator to about 75% of full scale using the front panel "C ZERO" control.

d. Adjust the front panel "COMP ADJ" controls (coarse and fine) for a maximum reading. (Readjust the "C ZERO" control to keep indications on-scale if necessary).

e. Having achieved a maximum reading, return the indicator to zero using the "C ZERO" control.

f. Switch to the 10,000 pF range, and observe the zero position of the indicator. If required, set to zero using the "10,000 pF ZERO" at the rear panel.

g. Switch one range at a time back to the 10 pF range, observing the zero position of the indicator for each range. If the zero position shifts appreciably for any range, repeat steps c through g. When properly adjusted, the zero position should be constant for all ranges.

NOTE:

Once properly set, the "10,000 pF ZERO" rarely needs readjustment. However, since its setting is essential to the proper operation of the instrument for either capacitance or inductance measurement, it is advisable to check it, following steps f and g above, at fairly frequent intervals.

h. Stretch a short length of copper strap between the "INDUCTANCE" terminals.

i. Switch the "L/C" switch to the "L" position. The indicator should read zero on the 10 μH range. If not, adjust for this reading using the "L ZERO" control. (See paragraph 2-2-3).

3-2 CAPACITANCE MEASUREMENTS

With the front panel "L/C" selector in the "C" position, the Model 71CR measures the "direct" capacitance of the test specimen. (The instrument ignores stray capacitance from the "LO" post to ground. Up to about 550 pF of capacitance from the "HI" post to ground can be nulled by adjustment of the "COMP ADJ" controls. As a result, the Model 71CR measures only the capacitance appearing between the "HI" and "LO" terminals.)

The measurements may be made either at the "TEST" terminals or remotely by connecting the specimen or test fixture via coaxial cables to the "TEST" terminals. By use of both the "DIFF" and "TEST" terminals differential capacitance measurements may be made within certain limitations.

3-3 LOCAL CAPACITANCE MEASUREMENTS

3-3-1 Connections for Local Measurements

While the capacitance connectors of the Model 71CR are intended primarily for attachment of coaxial cables, tests may readily be made locally by connecting the specimen directly to the terminals. A pair of Type UG-1090/U BNC-to-binding-post adapters are provided.

NOTE:

If any length of coaxial cables is used for connection, even a few inches, the measurement is considered remote and the instructions of paragraph 3-4 apply.

3-3-2 Checks and Adjustments Prior to Making Local Measurements

There are three controls whose adjustment should be checked before measuring.

a. "10,000 pF ZERO"

b. "COMP ADJ"

c. "C ZERO"

3-3-2-1 "10,000 pF ZERO" Adjustment

The "10,000 pF ZERO" control is located at the rear panel. Its setting is checked by switching to the 10,000 pF range and, with no specimen attached at the "TEST" terminals, observing the rest position of the pointer. If it does not read zero, follow the adjustment procedure outlined in paragraph 3-1-4-1, f and g.

3-3-2-2 "COMP ADJ" Peaking Adjustment

Prior to measuring at the "TEST" terminals, the "COMP ADJ" peaking adjustments should be performed as follows:

a. Attach any terminal adapters or connectors to be used for subsequent measurements to the "TEST" terminals and set the "RANGE" selector to the 10 pF range.

b. Adjust the "C ZERO" control for a reading of approximately 75% of full scale.

c. Adjust the "COMP ADJ" controls (coarse and fine) for a maximum reading. (Readjust the "C ZERO" control to keep deflections on scale if required.)

d. After peaking, zero the pointer using the "C ZERO" control.

e. Connect test specimen and read.

Once adjusted, the "COMP ADJ" control need not be readjusted (although periodic checking during extended periods of operation is advisable) unless some change in either the method of connection or the nature of the test samples substantially affects the stray capacitance from the "HI" post to ground.

IMPORTANT NOTE:

The above "COMP ADJ" adjustment procedure will suffice for the majority of measurements at the terminals for all ranges. However, to obtain the greatest possible accuracy when measuring capacitance standards or components on the 10, 30, or 100 pF ranges, or when the test sample has significant capacitance from the "HI" post to ground, the following procedure should be used:

a. Attach whatever terminal adapters or connectors are to be used in subsequent measurements to the "TEST" posts and connect a specimen typical of those to be measured. If no connectors are to be used, insert the leads of the specimen in the center conductors of the "TEST" posts.

b. Set the "RANGE" selector to the lowest range on which a reading of approximately 75% of full scale is possible. (On the lower ranges the "C ZERO" control may be of help in obtaining this reading.)

c. Adjust the "COMP ADJ" controls for maximum reading. (Readjust the "C ZERO" to keep deflections on scale if necessary.)

d. Disconnect the specimen from the "LO" post, leaving any terminal adapters to be used for subsequent tests in position, and zero the pointer with the "C ZERO" control. (See paragraph 3-3-2-3).

e. Re-connect test specimen and read.

3-3-2-3 "C ZERO" Adjustment

The front panel "C ZERO" adjustment is checked by switching to the 10 pF range. With the "COMP ADJ" control properly peaked and no specimen across the test terminals, observe the rest position of the pointer. If necessary, the pointer should be brought to zero using the front panel control. Any terminal adapters to be used in subsequent measurements should be left installed for this adjustment.

With "10,000 pF ZERO" and "C ZERO" controls properly set, the instrument will be correctly zeroed for all ranges (assuming the "COMP ADJ" controls are properly adjusted).

It is advisable to check the zero position periodically during the course of operation, particularly if working on the 10 or 30 pF ranges.

NOTE:

The front panel "C ZERO" control is a dual ratio control which adjusts a variable air capacitor having a full 360° of rotation. It will be noted that the "C ZERO" control turns very easily for about 270° of rotation. At this point the torque requirement increases abruptly, indicating a shift from the 36:1 "fine" adjustment to the 6:1 "coarse" adjustment.

3-4 REMOTE CAPACITANCE MEASUREMENTS

3-4-1 Connections for Remote Measurements

A test specimen or a test fixture may be connected to the "TEST" terminals by coaxial cables. RG-62/U is particularly recommended for this purpose because of its low capacitance.

3-4-2 Initial Adjustment for Remote Measurements

There are three controls whose adjustment should be checked before making remote measurements with this instrument:

a. "10,000 pF ZERO"

b. "COMP ADJ"

c. "C ZERO"

3-4-2-1 "10,000 pF ZERO" Adjustment

The "10,000 pF ZERO" control is located at the rear panel. Its setting is checked by switching to the 10,000 pF range and, with no specimen attached at the "TEST" terminals, observing the rest position of the pointer. If it does not read zero, follow the adjustment procedure outlined in paragraph 3-1-4-1, f and g.

3-4-2-2 "COMP ADJ" Peaking Adjustment

Prior to measuring remotely, the "COMP ADJ" peaking adjustment must be performed as follows:

a. Connect the coaxial cables and test fixture (if any) to be used in subsequent measurements to the "TEST" terminals. Set the range selector to 10 pF range.

b. Adjust the "C ZERO" control for a reading of approximately 75% of full scale.

c. Adjust the "COMP ADJ" controls (coarse and fine) for a maximum reading. (Readjust the "C ZERO" control to keep deflections on scale if required.)

d. After peaking, zero the pointer using the "C ZERO" control.

e. Connect test specimen and read.

Once adjusted, the "COMP ADJ" control need not be readjusted for some time (although periodic checking during extended periods of operation is advisable) unless some change in either the connection system or the nature of the test samples substantially affects the stray capacitance from the "HI" post to ground.

IMPORTANT NOTE:

The above "COMP ADJ" adjustment procedure will suffice for the majority of remote measurements. However, to obtain the greatest possible accuracy when using the 10, 30, or 100 pF ranges, or measuring capacitance standards, or when the specimen has significant capacitance from the "HI" post to ground, the following procedure should be followed:

a. Attach the coaxial cables and test fixtures (if any) which are to be used in subsequent measurements to the "TEST" posts and connect a specimen typical of those to be measured.

b. Set the "RANGE" selector to the lowest range on which, using the "C ZERO" control, a reading of approximately 75% of full scale is possible.

c. Adjust the "COMP ADJ" controls for maximum reading. (Readjust the "C ZERO" to keep deflections on scale if necessary.)

d. Disconnect the test specimen at the "LO" post and zero the pointer with the "C ZERO" control (See paragraph 3-4-2-3).

e. Reconnect test specimen and read.

3-4-2-3- "C ZERO" Adjustment

The front panel "C ZERO" adjustment is checked by switching to the 10 pF range. With the "COMP ADJ" control properly peaked and no specimen across the test terminals, observe the rest position of the pointer. If necessary, the pointer should be brought to zero using the front panel "C ZERO" control. (The coaxial cables and test fixture to be used in subsequent measurements should be attached for this adjustment.)

With the "10,000 pF ZERO" and "C ZERO" controls properly set, the instrument will be correctly zeroed for all ranges, assuming the "COMP ADJ" controls are properly adjusted.

It is advisable to check the zero position periodically during the course of operation, particularly if working on the 10 or 30 pF ranges.

NOTE:

The front panel "C ZERO" control is a dual ratio control which adjusts a variable air capacitor having a full 360° of rotation. It will be noted that the "C ZERO" control turns very easily for about 270° of rotation. At this point the torque requirement increases abruptly, indicating a shift from the 36:1 "fine" adjustment to the 6:1 "coarse" adjustment. If it is found that the "C ZERO" range is inadequate to zero out the external capacitance, its range may be extended as outlined in paragraph 3-7.

3-4-3 Errors in Capacitance Measurements Resulting from Series Inductance of Connecting Cables.

The measured capacitance, C_m, of a specimen may differ from the true capacitance, C_t, as a result of the series inductance of connecting cables and the inductance of the specimen. The error will be noted as an apparent increase in capacitance value in accordance with the following expression:

$$C_m = \frac{C_t}{1-\omega^2 L C_t} = \frac{C_t}{1-(X_L/X_{C_t})}$$

Or, if the true capacitance is required:

$$C_t = \frac{C_m}{1+\omega^2 L C_m} = \frac{C_m}{1+(X_L/X_{C_m})}$$

Where L = the combined series inductance of BOTH lengths of connecting coaxial cable and the inductance of the sample (generally small with respect to the cable inductance).

3-5 INCREASING THE CAPACITANCE MEASURING RANGE.

The upper capacitance limit of 10,000 pF may be increased by a factor of approximately 10 (to 0.1 μF) by use of the "DIFF" posts, as follows:

a. Set the instrument to the 10,000 pF range.

b. Attach a high quality capacitor whose value is accurately known to the "DIFF" terminals.

c. Attach the specimen to the "TEST" terminals.

d. The sum of the meter reading and the value of the capacitor at the "DIFF" terminals is the value of the test.

NOTE:

The value of the capacitor at the "DIFF" terminals should be selected to provide at least 15% of full scale deflection for most satisfactory results. It should be noted that while significant measurements can be made in this manner, accuracy will be degraded somewhat from that specified for the normal operating range of the instrument.

3-6 DIFFERENTIAL CAPACITANCE MEASUREMENTS

Measurement of the capacitance differential between two specimens may be made by attaching one sample at the "DIFF" terminals and the other to the "TEST" terminals, using all but the 10 pF range. The scale will read the capacitance differential directly in pF. (NOTE: If a down-scale reading is obtained, interchange the specimens connected to the "TEST" and "DIFF" posts for an up-scale reading.) The measurements must be made using the range on which one of the specimens alone would normally be measured, or one range below this for increased resolution. However, it is important not to switch down more than 1 range or serious errors may be introduced. Remote differential measurements may also be made using coaxial cables for connection. Samples connected for differential measurement may both be biased, since any voltage applied to the dc bias input appears across both the "TEST" and "DIFF" terminals.

Remote differential measurements may be made by connecting the specimens to the "TEST" and "DIFF" terminals with coaxial cables. The "COMP ADJ" adjustment procedures for remote differential measurements are the same as those for absolute measurements (see paragraph 3-4-2) except that the required connections and disconnections are made simultaneously at both sets of terminals.

3-7 EXTENDING THE RANGE OF THE "C ZERO" CONTROL

The front panel "C ZERO" control has sufficient range to zero out capacitance up to approximately 7 pF between the "HI" and "LO" test terminals. If it is found that greater range is required to zero out the capacitance of an external fixture, the range may be extended up to approximately 30 pF by connecting a high quality mica capacitor between the "HI" and "LO" "DIFF" posts. The amount of "C ZERO" range extension will equal the value of the capacitor at the "DIFF" terminals.

3-8 DC BIAS FOR CAPACITANCE TESTS

3-8-1 Application at the "BIAS" Terminals

The capacitance specimen may be biased by applying a dc voltage up to ±200 volts at 250 mA to the dc bias binding posts at the rear of the instrument. A 250 mA fuse adjacent to the bias binding posts prevents overload of internal circuits. Since any voltage applied to these binding posts appears across both the "TEST" and "DIFF" terminals, specimens for differential measurement are subjected to identical bias conditions.

3-8-2 Connection for High Voltage dc Bias

In cases where a dc bias voltage of greater than 200 volts is required, the circuit shown in Figure 3-1 may be used. With this arrangement, the practical limit of the bias that can be applied is the working voltage of the capacitor, C.

3-9 CAPACITANCE TEST SIGNAL

For capacitance measurements, the crystal controlled 100 KHz test signal is fixed at 15 millivolts RMS (±1mV). It is not adjustable, and any attempts to alter the test level will have a direct effect on measuring accuracy.

3-10 CAPACITANCE CALIBRATION PROCEDURES

3-10-1 Calibration Check of the Model 71CR with the Internal Standard Capacitor

a. Set the instrument to the 10 pF range and adjust the "COMP ADJ" controls as explained in paragraph 3-3-2-2 with no specimen at the "TEST" terminals.

b. On completing the "COMP ADJ" peaking, switch to the 1000 pF range.

c. With the Model 71CR set to the 1000 pF range and the OPERATE CAL 1/CAL 2 selector set to "CAL 1", note the meter reading.

CONNECTIONS FOR EXTERNAL BIAS - 71CR

$C_2 \approx 200(C_{TEST})$, WITH VOLTAGE RATING > E

L_1 & C_1 TO RESONATE @ 100 KHz.

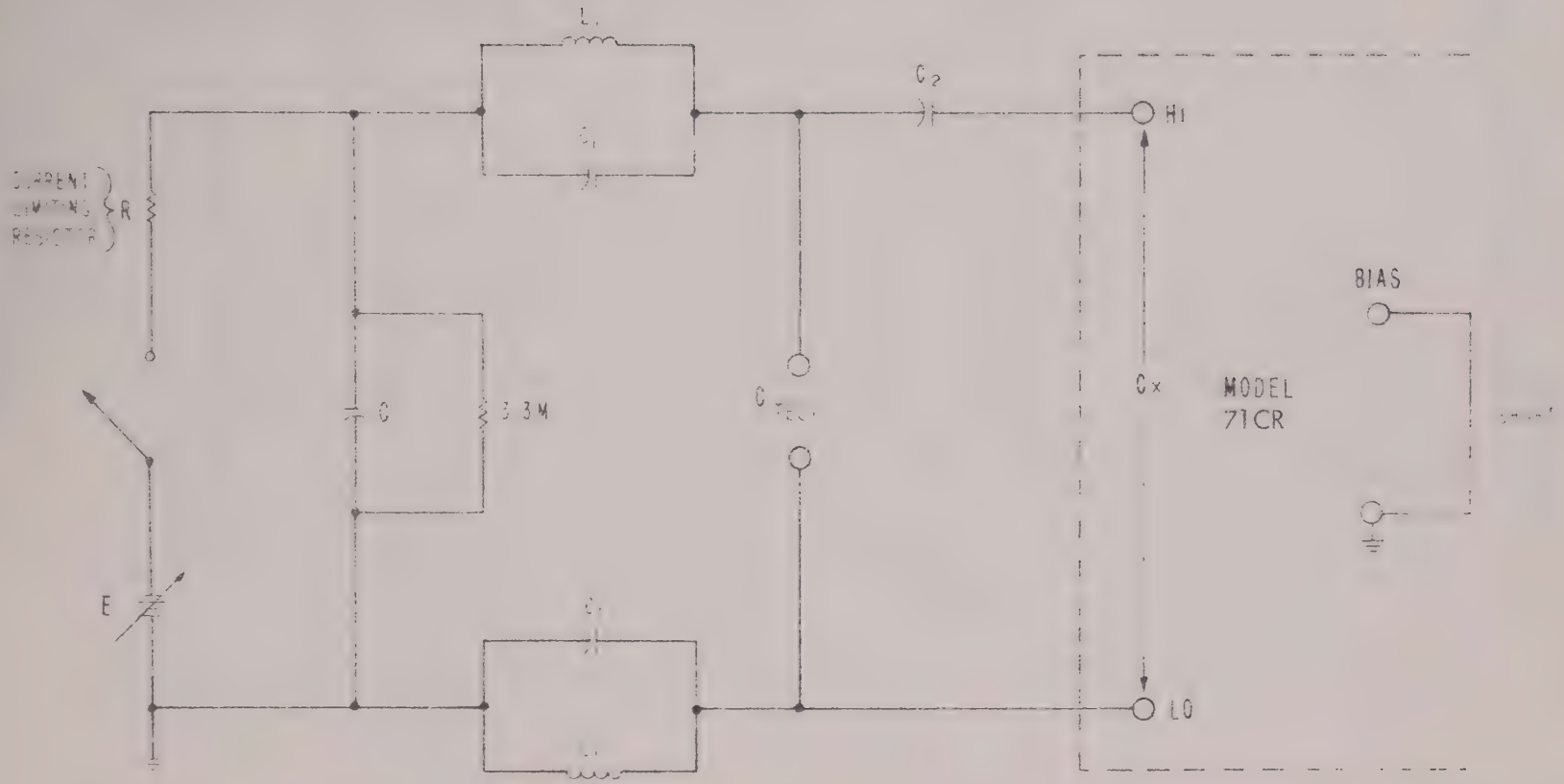

Figure 3-1

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d. Switch to the "CAL 2" position (which reduces the Q of the standard to 3) and again check the reading.

e. If the indicator reads 1000 pF for both tests, the instrument is in calibration. Otherwise perform the following calibration adjustments:

(1) Set selector to the "CAL 1" position and adjust the "CAL 1" control at the rear panel so that the meter reads 1000 pF.

(2) Set selector to "CAL 2". Adjust the "CAL 2" control at the rear panel of the instrument so that the indicator reads 1000 pF.

(3) Switch back to "CAL 1". If the instrument still reads 1000 pF, calibration is complete. If not, repeat steps a, b, and c until the instrument reads 1000 pF on both tests.

3-11 INDUCTANCE MEASUREMENTS

3-11-1 General

With the "L/C" selector in the "L" position the Model 71CR measures two-terminal inductance. It will be noted that with the "L" position, the normal resting place of the indicator, with no specimen connected to the "INDUCTANCE" terminals, is at the extreme right, above full scale; it moves down scale only when a specimen of measurable value for that range is placed across the terminals.

3-12 CONNECTIONS FOR INDUCTANCE MEASUREMENT

Inductance should be connected directly to the "INDUCTANCE" terminals.

3-13 INDUCTANCE ZERO CHECK

The Model 71CR can be quickly checked for L zero by placing a short length of copper strap tightly across the "INDUCTANCE" terminals, with the "RANGE" selector set at 10 μH. The reading should be zero. If not, the "L ZERO" control should be adjusted for this reading. (See paragraph 2-2-3). Once adjusted, the Model 71CR is properly set for all inductance ranges.

IMPORTANT NOTE:

The "10,000 pF ZERO" control should be properly set (see paragraph 3-1-4-1 f and g before checking the inductance zero position. The "10,000 pF ZERO" has a direct influence on inductance readings and once set, should not be disturbed during the course of measurement.

3-14 DC OUTPUT

3-14-1 General

A dc analog of the measured capacitance or inductance value is available in two modes (REC and DVM) as selected by connections at the rear panel. The output is valuable for such uses as application to a recorder, x-y plotter, digital voltmeter, voltage comparator, etc. Response time of the dc output is less than 20 milliseconds.

3-14-2 REC Mode

By connecting to the "REC" terminals, the output for all ranges varies linearly with the meter reading from 0 to a maximum of approximately 1.7 volts (into loads of 10 megohms or greater).

3-14-3 DVM Mode

Taking the output from the "DVM" terminals provides a voltage which varies from 0 to 100 millivolts or 300 millivolts for full scale deflection, depending on the numerics of the selected range. In cases where the output is used with a digital voltmeter having an input impedance of 10

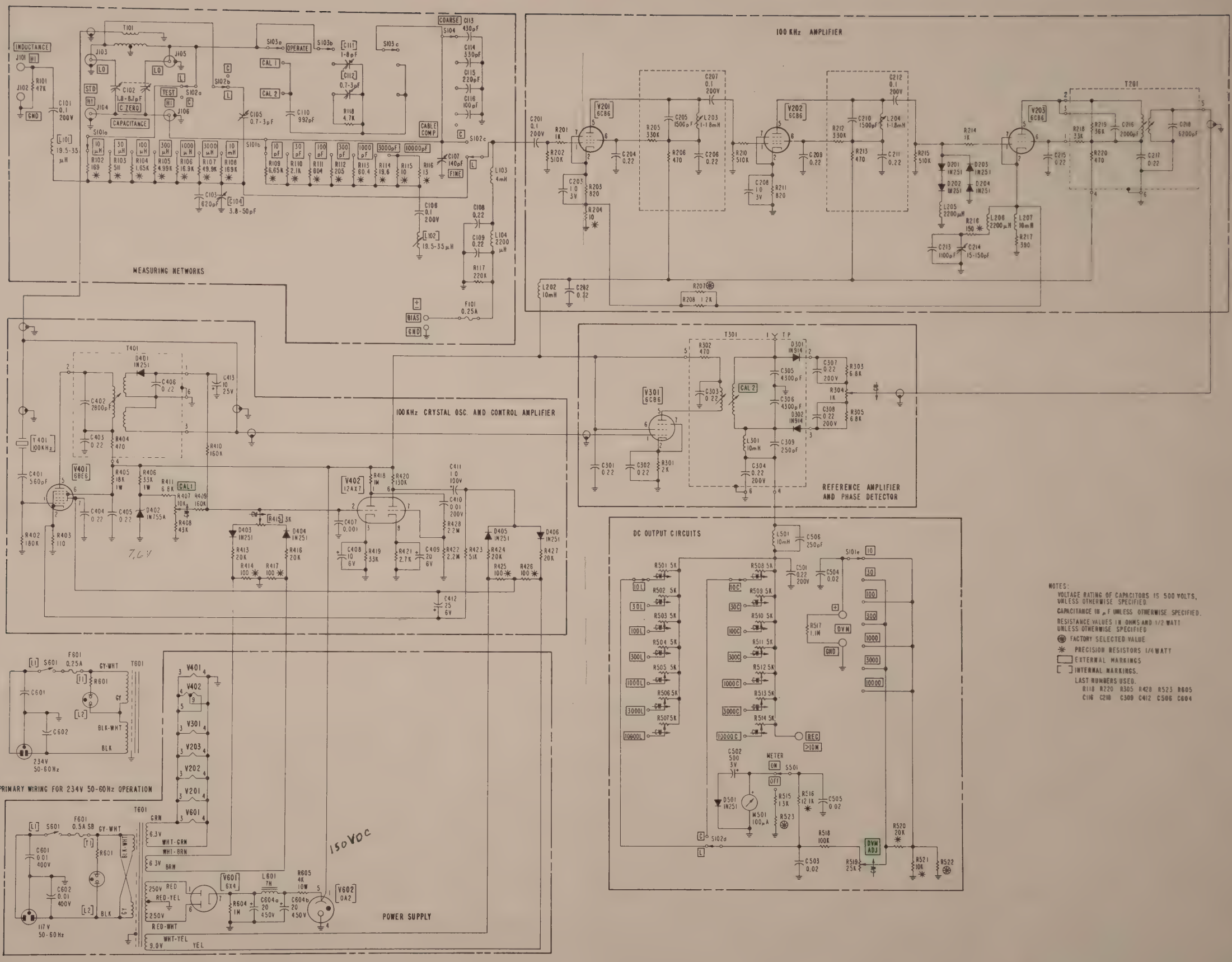
megohms or greater, the resistor supplied across the terminals should be left in position. For digital voltmeters having an input impedance of 1 megohm this resistor should be removed. If the input resistance of the DVM is less than 1 megohm, the 3:1 ratio of the internal attenuator will be in error.

3-14-4 DVM Output Adjustment

A control for the "DVM" output is provided on the rear panel to permit setting a digital voltmeter for exact agreement with a standard capacitor. To set this adjustment, attach a standard capacitor that will produce a suitable reading to the test terminals and set the range selector to the appropriate range. (The "COMP ADJ" must be properly adjusted.) With the digital voltmeter connected, adjust the "DVM ADJ" control so that the digital voltmeter indicates the value of the test. Once adjusted for a given digital voltmeter, the Model 71CR may be switched from range to range, and the digital voltmeter should follow correctly.

3-15 "METER ON/OFF" SWITCH

In cases where tests are being made at high speed in conjunction with a digital voltmeter, voltage comparator, or other external monitor, the meter should be switched off by means of the "METER-OFF" switch to avoid possible interaction caused by a small counter-emf from the moving coil of the meter. Also, this avoids damage and excessive wear of the movement. Whether the meter is switched on or off has sensibly no bearing on the value of the quiescent value of the dc output.



Schematic diagram for Model 71CR

Dwg. No. 830422 A

Warranty

Boonton Electronics Corporation warrants its products to the original Purchaser to be free from defects in material and workmanship and to operate within applicable specifications for a period of one year from date of shipment, provided they are used under normal operating conditions. This warranty does not apply to vacuum tubes that have given normal service, to sealed assemblies which have been opened, or to any item which has been repaired or altered without our authorization.

We will repair or, at our option, replace at no charge any of our products which are found to be defective under the terms of this warranty.

SHIPPING INSTRUCTIONS

If it becomes necessary to ship the instrument, the following steps should be followed:

a. Wrap the instrument with heavy wrapping paper and seal the seams with gummed tape. Place in fibreboard carton large enough to permit three inches of soft packing material between instrument and sides of box.

b. Alternatively Boonton Electronics will provide an appropriate shipping container and packing materials at nominal cost. These may be obtained by writing to the Sales Department, Boonton Electronics Corporation, Route 287 at Smith Rd., Parsippany, N. J. 07054.

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